9040-63-479
Copy No. 5

BT-1943
Prop Sec
Jim

4 February 1963

25X1A

TO: [redacted]

SUBJECT: Exhibit A to Contract BT-1943, Work Statement - and - Specification For A Panoramic Camera Subsystem No. 43961

Enclosed are two (2) copies each of Revisions A and B respectively of the referenced documents which are submitted for approval and incorporation into the next contract change notice.

By copy of this letter I am forwarding the quantities indicated below to the named distribution. It is requested that the appropriate members of the CCB and SE TWX approval of these revised documents to you in order that they may be incorporated.

The first three changes on the Work Statement errata sheet were previously submitted for approval. The balance of the changes which essentially delete the references to the Stellar/Index cameras are the result of the agreement by SE and the CCB to do so. The changes at the bottom of page 2 and as contained on page 3 are those required to reflect the Three- (3) Unit Follow-On effort. Changes on page 4 are necessary as a result of TD-1016 and TD-1020.

Revision A to Specification No. 43961 represents those changes made to the document at the time of negotiation of our Definitive Contract and have been in full force and effect since 6 August 1962.

The Revision B changes in paragraph 2.1 reflect revisions to the applicable documents that have occurred since 6 August 1962. All other changes, with the exception of paragraph 4.4.4, result from the agreement by the CCB and SE to delete references to the Stellar/Index camera. The change to paragraph 4.4.4 was approved by specific TWX as a separate matter.

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A delay in the prompt approval of these changes will affect the execution of our Contract Change Notice which in turn will have side effects on the ability to have invoices cleared. It is, therefore, again requested that interested parties give their prompt attention to the approval of these documents.

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Very truly yours,

[redacted]

DJ:cm
Enclosures (4)

cc: [redacted]

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9040-63-548
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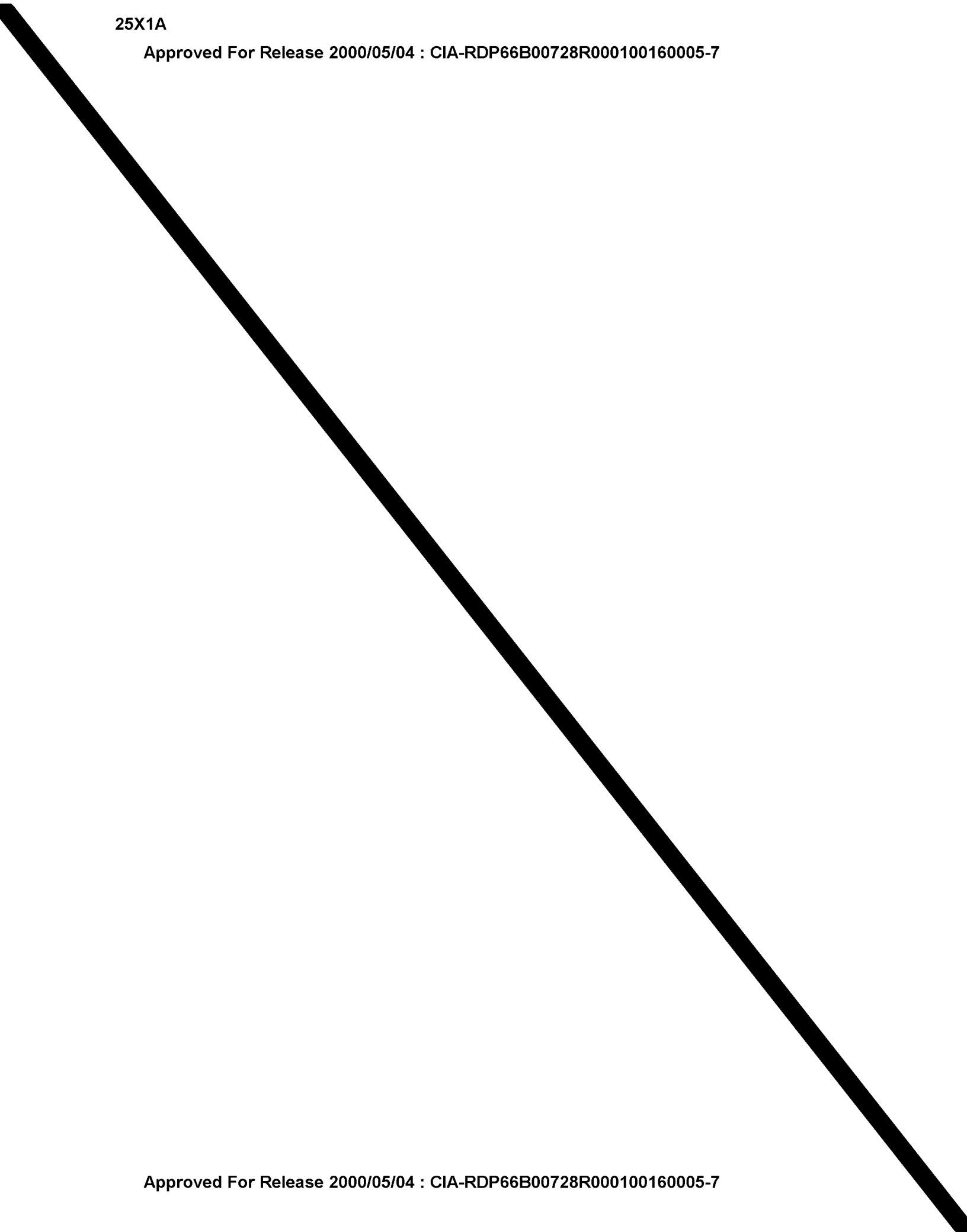
COR-2087
COPY 1 OF 3

CONTENTS

	Page Numbers
Total Cost Summary	1
Boston	2
Manufacturing and Test	3
Cost Summary	4
Materials	5
Engineering	6
Cost Summary	7
Optics	8
Cost Summary	9
Materials	10
Program Management, Administration, and Support	11
Cost Summary	12
Materials	13
Communications	13
Security	13
Travel Schedule	14
Labor Rate Schedule	15
Palo Alto Support	16
Total Cost Summary	17
Materials	18
Communications	18
Travel Schedule	19
Labor Rate Schedule	20
25X1A [redacted] Thermal Study	21
Total Cost Summary	22
Travel Schedule	23
Computor Rental	23
Funding Forecast	24



Approved For Release 2000/05/04 : CIA-RDP66B00728R000100160005-7

BOSTON

MANUFACTURING AND TEST

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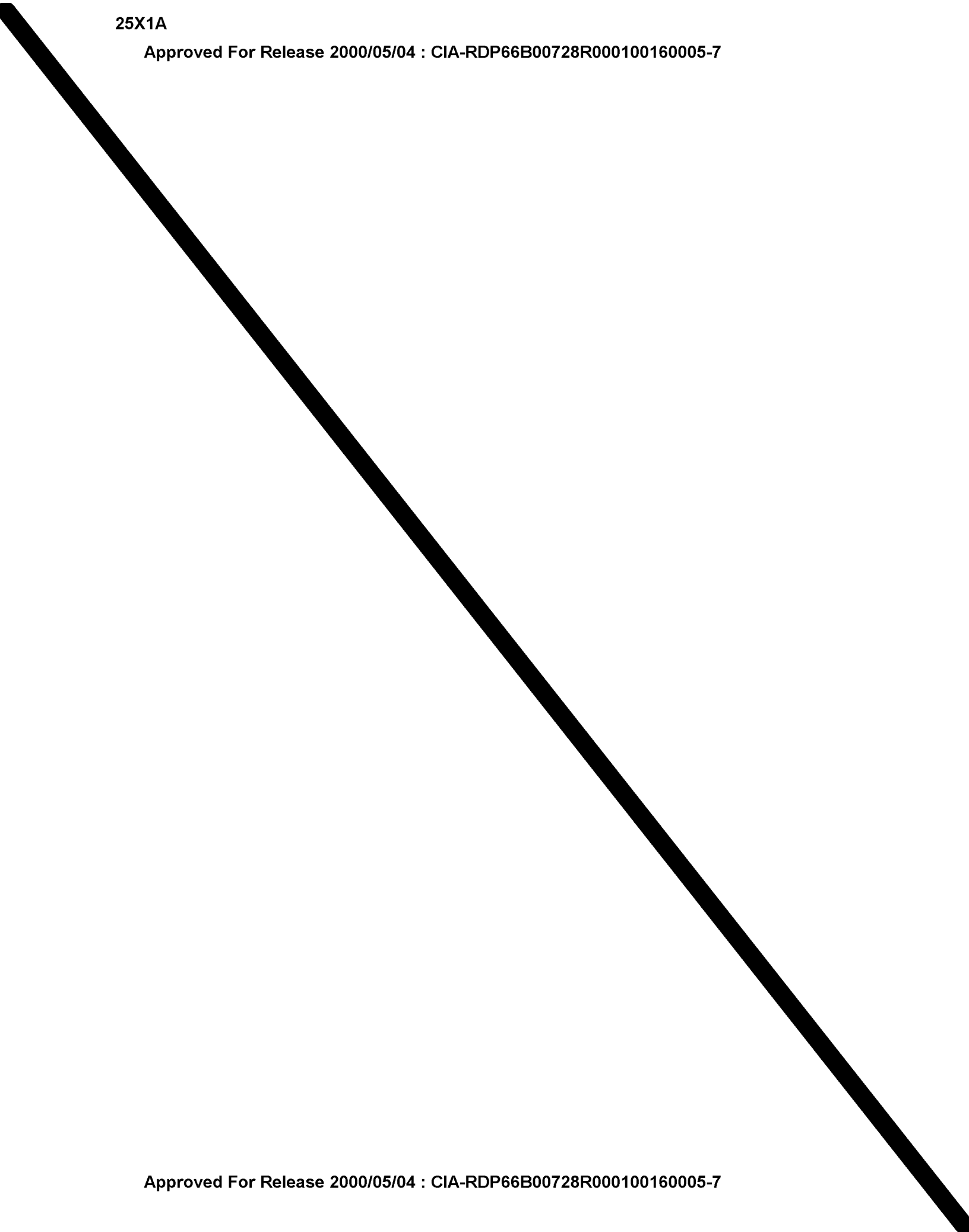
ENGINEERING



OPTICS

Next 1 Page(s) In Document Exempt

PROGRAM MANAGEMENT, ADMINISTRATION AND SUPPORT

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PALO ALTO SUPPORT

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25X1A

[redacted] THERMAL STUDY

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REVISION B

(Per [redacted] - 12/03/62 and 1/23/63)

Paragraph	Was	Is
1.1	First Sentence: "This specification covers the requirements for a high-acuity panoramic camera and associated stellar/index cameras as defined in Systems Requirements Specification SP2-126."	"This specification covers the requirements for a high-acuity panoramic camera as defined in Systems Requirements Specification SP2-126."
2.1	Under Specification Number Column: "1072045" Under Date of Issue Column: " - "	"1072045D" Add: "8 December 1960"
	Under Specification Number Column: "43704D" Under Date of Issue Column: "No Date"	"43704F" Change to: "12 July 1962"
	Under Specification Number Column: "SP2-156" Under Date of Issue Column: "10 May 1962	"SP2-156C" "9 September 1962"
	Under Date of Issue Column: "No Date" (opposite T55-100)	"14 July 1962"
3.1.3	Last Sentence: "A stellar (attitude)/index (terrain) camera is provided for an additional 20 pounds."	Delete in its entirety.

SPECIAL HANDLING

TITLE

SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM

43961

SECRET

Sheet of Sheets

REVISION B/continued

Paragraph	Was	Is
3.4	First Sentence: "The camera subsystem shall satisfy the high-acuity, panoramic camera concept and shall also include a stellar (attitude recording)/index (high-resolution terrain) camera, and a take-up cassette which will be independently mounted in a recovery capsule."	"The camera subsystem shall satisfy the high-acuity, panoramic camera concept and shall include a take-up cassette which will be independently mounted in a recovery capsule."
3.4.1	Last Sentence: "Tests shall be conducted for qualification and acceptance of equipment using a 2:1 contrast Air Force test pattern of the type defined in MIL-STD-150A."	"Tests shall be conducted for qualification and acceptance of equipment using an Air Force test pattern of the type defined in MIL-STD-150A." ADD: "Target contrast shall be that required to present 2:1 contrast at the camera mirror."
3.5.8	" - "	Insert paragraph which was 3.10.1.5 as corrected below. "Stellar/Index Control and Programming: The associate shall provide a signal to initiate and continue operation of the Stellar/Index Camera Subsystem, as required throughout the mission. The panoramic camera will act as the intervalometer, proportional to V/h, and provide all subcycle commands required by the stellar/index camera, whether or not panoramic photography is being accomplished. Stellar/index photography will be accomplished at a ratio of one exposed frame for every ten panoramic cycles and expose no more than three (3) S/I frames for each sixteen (16) frame bursts of the panoramic instrument. The S/I camera shall operate whenever the main instrument operates

TITLE

SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM

SPECIAL HANDLING

43961

Paragraph No.	WAS	IS
A.1	". . . Contractor's Specification No. 43961, dated 19 June, 1962, . . ."	". . .Contractor's Specification No. 43961, Revision B, dated 5 December 1962, . . ."
A.3.n	"Design & fabricate 3 sets vertical installation sling assemblies."	"Design & fabricate 3 each instrument handling fixtures."
B.3.n	"Design & fabricate 3 sets vertical installation sling assemblies. "D B Date 1 9-14-62 2 10-15-62"	"Design and fabricate 3 each instrument handling fixtures. "D B Date Pan 3 Concurrent"
	The following changes are made to reflect deletion of the stellar/index cameras to be GFE'd at Boston and to accomplish integration at A/P by the 9040 field engineering group:	
A.1	"...Subsystems incorporating the five (5) GFE Stellar Index Cameras in ..."	"...Subsystems in accordance..."
A.6	"... dated 14 May 1962."	"... dated 14 May 1962. These services shall include integration of the Stellar/Index camera Subsystems as furnished to the LMSC facility by Itek under separate contract."
A.10	"Contractor shall furnish the following manuals and data: "a. Provide GFP Class III..." "b. Provide twenty (20)copies... "c. Provide twenty (20)copies... "These manuals shall contain... "d. Provide SE (System Engineering)..."	"Contractor shall furnish the following manuals and data: "a. Provide twenty (20) copies... "b. Provide twenty (20) copies... These manuals shall contain... "c. Provide SE (System Engineering)..."
A.10.c	"Provide SE (System Engineering) with documentation of each Panoramic and Stellar/Index Camera Subsystem consisting of:"	"Provide SE (System Engineering) with documentation of each Panoramic Camera Subsystem consisting of:"
A.10.c.8	"Stellar/Index Camera Susbystem documentation as furnished with each unit."	Delete sub-paragraph in its entirety.

EXHIBIT "A" TO CONTRACT BT-1943

REVISION 4

Paragraph No.	WAS	IS
B.1.b	"Stellar-Index Camera Subsystems, Five (5) "First Delivery 22 November 1962 "Second Delivery 22 December 1962 "Third Delivery 22 January 1963 "Fourth Delivery 22 February 1962 "Fifth Delivery 22 March 1963"	Delete sub-paragraph in its entirety.
C.4	"Stellar-Index Camera Subsystems, five (5) including Transit Cases, Supply Spools, and Class III Utility Manuals. "First Delivery 1 November 1962 "Second Delivery 1 December 1962 "Third Delivery 1 January 1963 "Fourth Delivery 1 February 1963 "Fifth Delivery 1 March 1963	Delete sub-paragraph in its entirety.
C.5	"Stellar-Index Camera Subsystem Ground Handling and Test Equipment, three (3) sets - each set consists of a test and checkout console and a mount. "First Set 1 November 1962 "Second Set 15 November 1962 "Third Set 1 March 1963"	Delete sub-paragraph in its entirety.
C.8	S-I Cassetts, two (2) "First Delivery 17 August 1962 "Second Delivery 7 September 1962"	Delete sub-paragraph in its entirety.
C.--	Item 6 Item 7 Item 9	Item 4 Item 5 Item 6
- - -	- - - - - - - - - - - - -	- - - - - - - - - - - - -
	The following changes are made as a result of the Three- (3) Unit Follow-on Proposal:	
A.1	"...fabricate five (5) each..."	"...fabricate eight (8) each..."
A.3.j.	"...5..."	"...8..."
A.3.l	"...7..."	"...9..."
A.3.m	"...78..."	"...103..."

Paragraph No.	WAS	IS
A.5	"Furnish 83 film support spools..."	"Furnish 125 film supply and take-up spools..."
B.1.a	"Panoramic Camera Subsystem, Five (5), (less supply spools) "Serial No. 11 22 March 1963 "Serial No. 12 22 November 1962 "Serial No. 13 22 December 1962 "Serial No. 14 22 January 1963 "Serial No. 15 22 February 1963"	"Panoramic Camera Subsystem, Eight (8), (less supply spools) "Serial No. 11 22 March 1963 "Serial No. 12 22 November 1962 "Serial No. 13 22 December 1962 "Serial No. 14 22 January 1963 "Serial No. 15 22 February 1963 "Serial No. 16 1 May 1963 "Serial No. 17 1 July 1963 "Serial No. 18 1 August 1963"
B.3.j	"Design & fabricate 5 each 'Strong Backs' "D/5 B Date Pan Concurrent	"Design & fabricate 8 each 'Strong Backs' "D/8 B Date Pan Concurrent
B.3.l	"Fabricate 7 each Cassette transit cases "D/7 B Date 9-14-62 10-12-62 Pan Concurrent	"Fabricate 9 each Cassette transit cases "D/9 B Date 9-14-62 10-12-62 Pan Concurrent
B.3.m	"Modify the design and supply 78 sets each film transit case spiders and protective flanges. "D/78 B Date 6 - August 6 - September 24 - October 12 - November 12 - December 12 - January 6 - February	"Modify the design and supply 103 sets each film transit case spiders and protective flanges. "D/103 B Date 6 - August 6 - September 24 - October 12 - November 12 - December 12 - January 6 - February 13 - March 12 - April
B.6	"...through 31 August 1962."	"...through 31 November 1963."

EXHIBIT "A" TO CONTRACT BT-1943

REVISION "A"

Paragraph No.	WAS	IS
	The following additions are made as a result of TD-1016 and TD-1020.	
A.6	"...Itek under separate contract."	"...Itek under separate contract. The DRT installed under Item 11 below shall be maintained and operated per TD-1020."
A.11	--------	(New Item) "Contractor shall install and test a Dynamic Resolution Tester on the LMSC furnished seismic block in the conditioned area in accordance with TD-1016."
B.11	--------	(New Item) "LMSC Dynamic Resolution Tester - 14 February 1963."

TITLE

EXHIBIT "A" TO CONTRACT BT-1943

EXHIBIT "A"

CONTRACT NO. BT-1943

A. Contractor shall furnish the necessary facilities, materials, and services to accomplish the Statement of Work set forth below and make delivery to the Government at the times and places specified herein below:

STATEMENT OF WORK

Item 1. - Design, develop, and fabricate eight (8) each Panoramic Camera Subsystems in accordance with Contractor's Specification No. 43961, Revision B, dated 5 December 1962, including the supplement, attached thereto, said documents being incorporated by reference, together with such changes as may be agreed to between the Contractor and the Contracting Officer.

Item 2. - Provide mock-ups of the subsystems as follows:

a. One (1) each space mock-up which simulates the outer configuration only for use by LMSC.

b. One (1) each structural mock-up which is weight and mass simulation of the system for use by LMSC.

Item 3. - Contractor shall furnish the following GHE and GSE:

a. Modify 2 each GF (Gov't. Furnished) 2-Bay Checkout Consoles.

b. Modify 2 each GF 3-Bay Checkout Consoles.

c. Modify 2 each GF Instrumentation Consoles.

d. Design & fabricate 2 each Instrumentation Consoles.

e. Design & fabricate 2 each 2-Bay Checkout Consoles.

f. Design & fabricate 1 each 3-Bay Checkout Console.

g. Design & fabricate 3 each Test and Integration Dollies.

h. Design & fabricate 1 each STM (Structural Test Model) dolly.

i. Design & fabricate 2 each interface templates.

j. Design & fabricate 8 each "Strong Backs".

k. Design & fabricate 3 each Pan transit cases.

l. Fabricate 9 each Cassette transit cases.

m. Modify the design and supply 103 sets each film transit case spiders and protective flanges.

n. Design & fabricate 3 each instrument handling fixtures.

Item 4. - Provide LMSC with two (2) additional subsystem cassette assemblies for test and checkout purposes.

Item 5. - Furnish 125 film supply and take-up spools for the camera subsystem. Delivery shall be made in accordance with the Film/Spool/Transit Case schedule developed by the Contractor. Contractor shall provide protective flanges for the GFE transit cases.

Item 6. - Furnish necessary field engineering services to support the subsystems at LMSC and VAFB in accordance with Detailed Field Engineering and Flight Support Work Statement, dated 14 May 1962. These services shall include integration of the Stellar/Index Camera Subsystems as furnished to the LMSC facility by Itek under separate contract. The DRT installed under Item 11 below shall be maintained and operated per TD-1020.

Item 7. - Contractor shall furnish spares in accordance with the following:

a. On or before 15 August 1962, Boston shall furnish SE seven (7) copies of a production list containing the part number, description, and quantity of those parts deemed necessary by Boston to support the equipments after shipment from Boston, considering the delivery schedule and two facilities. This list shall indicate those long lead-time items already released to support the equipments.

b. If within thirty (30) days from the date of submission, the SE and the Customer has neither approved or disapproved all the items contained in such production lists, those items shall be deemed to have been authorized for provisioning purposes. In the event items are disapproved by the Customer, procurement activity shall be terminated where necessary.

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c. Spares shall be shipped to [redacted] F.O.B. the [redacted] facility for maintenance of accountability in a segregated Stores Area. The parts shall be available to Boston's Field Engineering and Flight Support Group to replace those parts as may be necessary to certify flight readiness of the camera subsystems.

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d. The cost, fixed-fee, and delivery schedule of these spares shall be determined at a later date.

Item 8. - Contractor shall perform Inspection, Qualification and Acceptance tests in accordance with Specification No. 43961 and the following:

a. Inspection of the material to be delivered from Boston shall be at a level deemed necessary by Boston and approved by the Government to insure performance. Boston shall provide

additional inspection services in the event performance verification or rework is necessary to such material after acceptance and delivery. Boston shall also verify that no damage in transit has occurred to its materials after shipment from one facility to another.

b. Shipment is F.O.B. Lexington, Massachusetts, via such carriers and to such destinations as may be designated by the customer. Boston will provide instrument transit cases.

c. Final acceptance of equipment and materials to be delivered shall be at Boston. SE and other Customer's representatives will be notified five (5) days prior to the beginning of final acceptance tests. These tests shall be administered in accordance with the approved Acceptance Test Procedures. Requests for waivers on end item equipment deliveries shall be submitted to SE/TD for resolution. The execution of a DD Form 250 by Itek, which may contain concurrence signatures of SE and other Customer's representatives, shall constitute final acceptance. Copies of the DD Forms 250 will be forwarded to the Contracting and Finance Officers.

d. All Qualification and Acceptance Test Specifications and Procedures (QTS/QTP and ATS/ATP) shall be prepared by the Contractor and the QTS and ATS shall be approved by SE/TD prior to the performance of the Qual. or Acceptance Test, whichever is applicable.

Item 9. - Contractor shall furnish the following reports and attend required meetings as follows:

a. Weekly TWX progress report - to be forwarded to SE/TD on Wednesdays and shall report significant highlights of development for the preceding week - ending Saturday.

b. Monthly TWX Financial Report - to be forwarded the 20th of each month for the preceding Boston accounting month.

c. Weight Report - to be forwarded every two (2) weeks to SE showing current weight estimate and first and second moments of inertia. Should the details of the report be unchanged, a TWX statement to that effect will be forwarded in lieu of the report.

d. System Qualification Test Report - to be forwarded to SE/TD two (2) weeks or sooner after completion of each major subassembly test phase. A consolidated, summarizing report shall be forwarded forty-five (45) days after the Subsystem Qualification Test Program.

e. Subassembly Qualification Test Reports - to be forwarded to SE/TD two (2) weeks or sooner after completion of each major subassembly test phase. A consolidated, summarizing report

shall be forwarded forty-five (45) days after the Subsystem Qualification Test Program.

f. Acceptance Test Reports - to be forwarded as part of each subsystem logbook.

g. Post-flight Engineering Analysis Report - ten copies (10) to be forwarded to SE/TD upon completion of each analysis. LMSC will furnish Contractor with copies of all pertinent telemetering data obtained during flight for engineering analysis by contractor of camera subsystem performance.

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h. Systems Engineering Meetings shall be held once each month alternately at [redacted] and Boston. Such meetings shall be chaired and minutes prepared and distributed by SE. Contractor shall present such briefing aids and data as required.

Item 10. - Contractor shall furnish the following manuals and data:

a. Provide twenty (20) copies of a Class III Manual of Operation and Service Instructions for the Panoramic Camera Subsystem.

b. Provide twenty (20) copies of a Class III Manual of Operation and Service Instructions for Ground Support Equipment.

These manuals shall contain sufficient information to install, maintain, and operate the equipments and shall also contain such illustrations, safety notes, schematics, and drawings as are required. These manuals shall be in sufficient detail for the use of personnel operating research and development programs. Delivery shall be accomplished within forty-five (45) days after delivery of the first flight units.

c. Provide SE (System Engineering) with documentation of each Panoramic Camera Subsystem consisting of:

1. Panoramic Camera Subsystem Logbook.
2. Calibration Data.
3. Pan Subsystem Electrical Schematics as wired (three each). These drawings may be red-lined.
4. Results of Acceptance Tests.
5. Revisions to Operation and Service Instructions Manual as required.
6. Electrical Interface list per SP2-156.
7. Results of 2:1 contrast photo tests.

Item 11. - Contractor shall install and test a Dynamic Resolution Tester on the LMSC furnished seismic block in the conditioned area in accordance with TD-1016.

B. Delivery - Contractor shall deliver the work called for above in accordance with the following schedule. Unless otherwise specified, acceptance and inspection shall be at Contractor's plant or plants of shipment made F.O.B. Contractor's plant, Lexington, Massachusetts.

Item 1. -

a. Panoramic Camera Subsystem, Eight (8), (less supply spools)

Serial No. 11	22 March 1963
Serial No. 12	22 November 1962
Serial No. 13	22 December 1962
Serial No. 14	22 January 1963
Serial No. 15	22 February 1963
Serial No. 16	1 May 1963
Serial No. 17	1 July 1963
Serial No. 18	1 August 1963

Item 2. -

a. Space Mock-up, Pan Camera Subsystem - 21 June 1962

b. Structural Test Model, Pan Camera Subsystem - 20 August 1962

Item 3. - Contractor shall deliver GHE and GSE as follows:

	D	B	Date
a. Modify 2 each GF (Gov't. Furnished) 2-Bay Checkout Consoles		2	9-15-62
b. Modify 2 each GF 3-Bay Checkout Consoles	1	1	11-16-62
c. Modify 2 each GF Instrumentation Consoles		2	11-26-62
d. Design & fabricate 2 each Instrumentation Consoles	2		11-22-62 12-28-62
e. Design & fabricate 2 each 2-Bay Checkout Consoles	1	1	11- 2-62 12-22-62
f. Design & fabricate 1 each 3-Bay Checkout Consoles	1		12-14-62
g. Design & fabricate 3 each Test & Integration Dollies	2	1	10-12-62 11-22-62 12-22-62
h. Design & fabricate 1 each STM (Structural Test Model) dolly	1		7-19-62
i. Design & fabricate 2 each interface templates	2		8- 3-62

		D	B	Date
j.	Design & fabricate 8 each "Strong Backs"	8		Pan Concurrent
k.	Design & fabricate 3 each Pan transit cases and recycle	3		Pan Concurrent
l.	Fabricate 9 each Cassette transit cases	7		9-14-62 10-12-62 Pan Concurrent
m.	Modify the design and supply 103 sets each film transit case spiders and protective flanges.	103		6 - August 6 - September 24 - October 12 - November 12 - December 12 - January 6 - February 13 - March 12 - April
n.	Design & fabricate 3 each Instrument Handling Fixtures	3		Pan Concurrent

Item 4. - Cassette Subassemblies, Panoramic, Two (2)

First Delivery	14 September 1962
Second Delivery	12 October 1962

Item 5. - Film Supply Spools

One each per Pan Camera Subsystem plus additional quantities per Integrated Spool/Film/Transit Case Plan.

Item 6. - Field Engineering Services shall be furnished as required for the period of performance of this Contract, contemplated to be through 31 November 1963.

Item 7. - Spare parts shall be delivered in accordance with Item 7 of Paragraph A of this Work Statement.

Item 8. - Qualification, Inspection and Acceptance shall be performed in accordance with Item 8 of Paragraph A of this Work Statement.

Item 9. - Reports. Deliver in accordance with a. through h. of Item 9 of Paragraph A of this Work Statement.

Item 10. - Manuals and Data. Deliver in accordance with Item 10 of Paragraph A of this Work Statement, provided that documentation

Item 11. - LMSC Dynamic Resolution Tester - 14 February 1963.

in subparagraph d. shall be furnished on or within 10 days of date of shipment of each system.

C. Furnished Equipment

Item	Description	Delivery Date
1.	One (1) 300 inch Collimator	Forthwith
2.	Film and film transit cases as required for testing and checkouts	Per Plan
3.	Residual inventory from Contractor's terminated subcontract P.O. 28-607 with LMSC for the E-5 System. Evidence of this transfer of inventory will be accomplished as an amendment to this Contract BT-1943.	
4.	Clock Simulator, two (2)	
	First Delivery	30 June 1962
	Second Delivery	25 August 1962
5.	System Outer Skin, Fairing Subassembly, and Adapter	15 September 1962
6.	Actual Vehicle Power Supply, one (1)	1 September 1962

REVISION A

(Per Supplement 8-6-62)

Paragraph	Was	Is
3.8.1	Line 7 4:1 Contrast	2:1 Contrast
	Last Sentence: "DT shall be a design goal to acheive 80 lines/mm or greater at 2:1 contrast."	Deleted
3.4.1	Last Sentence: "Tests shall be conducted for qualification and acceptance of equipment using a 4:1 contrast Air Force test pattern as defined in MIL-STD-150."	"Tests shall be conducted for qualification and acceptance of equipment using a 2:1 contrast Air Force test pattern of the type defined in MIL-STD-150A".
3.1.3	First Sentence: "680 pounds"	"627 pounds"
	Third Sentence: "20 pounds"	"17 pounds"
4.3.2.1.2		Add "Subject the cassette to 20g's for 3 shocks in each direction along X axis. Axes defined in T55-100.
4.3.1.1	Shock Test: "The complete Camera shall operate after being subjected to the required shocks. Operation during shock is not	Deleted

9040	TITLE SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	Sheet of Sheets

REVISION A/continued

Paragraph	Was	Is
4.3.1.1/continued	required. The provisions of paragraph 4.9 of 6117 are applicable. Table III, Payload (preliminary) test conditions shall apply."	
	APPENDIX A	
1.0 g	"Delete paragraphs 3.2.1, 3.2.2.1, 3.2.2.2, and 3.2.2.3."	"Delete paragraphs 3.2.1, 3.2.2.2, and 3.2.2.3."

9040-62-76 B

SECRET

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REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	Rev. per Supplement 8-6-62	10-17-62	
B	Rev. per [redacted] Memo 12-3-62 & 1-23-63	12-4-62	

25X1A

DOCUMENT NO. 10
NO CHANGE IN CLASS. ☒
☐ DECLASSIFIED
CLASS. CHANGED TO: TS S C 2011
NEXT REVIEW DATE:
AUTH: HR 70-2
DATE: 13 July 87 REVIEWER: 008632

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Specifications ✓ Procedures

Engrg		
Engrg		
Engrg		
Engrg		
Project		
QA App'd		
SE App'd		
Issued	19 June 1962	

TITLE

SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM

SPECIAL HANDLING

9040

SECRET

43961

Code

1.0 SCOPE

1.1 Objective: This specification covers the requirements for a high-acuity panoramic camera as defined in Systems Requirements Specification SP2-126. The panoramic camera is to provide programmed vertical and stereo photographs at a resolution level of [redacted] The system is to be designed to be used in a light-tight structure and will allow recovery of the film only. 25X1D

2.0 APPLICABLE DOCUMENTS

2.1 The following publications of the issue in effect as of date of issue indicated, shall form a part of this specification to the extent specified herein. In the event of conflicting provisions, the requirements of this specification shall prevail. See Appendix A.

Specification Number	Title	Date Of Issue
MIL-STD-150A	Photographic Lenses	12 May 1959
6117B	Environmental Test, Specification	1 July 1960
MIL-E-1D	Electron Tubes and Crystal Rectifiers	31 March 1958
447969A	Systems Electrical Interface Specification	9 April 1962
1072045D	Cable Design Control Specification	8 December 1960
SP2-156C	Electrical Interface	9 September 1962
T55-100	Interface Drawing	14 July 1962
43704F	Format Drawing	17 July 1962
SP-0004A	Process Specification, Film Type SO-132	
SP2-126	Systems Requirements Specification	3 April 1962
49346A	Spooled Film	14 September 1962
TD-55	Semi-Conductor X-ray Inspection	
1326684A	Mirror, Metal	20 July 1961

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		Sheet 2 of 28 Sheets

3.0 REQUIREMENTS

3.1 General

3.1.1 General Requirement: The cameras shall conform to the requirements of this specification.

3.1.2 Parts, Materials, Processes: Shall be consistent with flight objectives and good design practices. When and where applicable, MIL standards and specifications for space equipment shall be used as a guide.

3.1.3 Weight: Total weight of the panoramic camera including empty supply spool but excluding cassette shall not exceed 627 pounds as a design objective. Maximum film capacity will be 75 pounds. The cassette shall not exceed 17 pounds.

3.1.4 Identification: Itek nameplates including main assembly part number and serial number will be supplied. The name "Itek" will not be indicated.

3.2 Selection of Specifications and Standards

3.2.1 Standard Parts: AN or MIL standard parts shall be used wherever possible.

3.2.2 Commercial Parts: In applications for which no suitable corresponding AN or MIL part exists or where they are not readily available, qualified commercial parts may be used.

3.3 Material

3.3.1 Metals: Metals shall be of the non-corrosive type or be suitably protected (subject to the thermal requirements) to resist corrosion during maximum service life. (Test, storage, and flight.)

3.3.2 Semi-Conductors: To aid in establishing a ground rule philosophy in semi-conductor selection, the following guides are offered.

3.3.2.1 Requirements and characteristics of MIL-E-1D must be considered minimum, and no component shall be used that is not vendor-certified or tested to the limits of that specification.

3.3.2.2 The environmental requirements of 6117 may be used as minimum levels, provided sufficient de-rating is applied to verify thermal competence.

3.3.2.3 All semi-conductors must be X-ray inspected, per TD-55.

3.3.3 Electrical: Interface power and power distribution characteristics shall be as specified by 447969, System Electrical Interface. 447969 shall be used as a guide for Camera System power and signal distribution, shielding, and grounding.

3.4 System Design Objective: The camera subsystem shall satisfy the high-acuity, panoramic camera concept and shall include a take-up cassette which will be independently mounted in a recovery capsule. Electrical circuits, controls, and cycling programmer capable of operating on commands from the vehicle programmer shall be included. Instrumentation which will provide inputs to the vehicle telemetry system to monitor critical functions of cameras while in flight will be established as indicated in RP2-156.

3.4.1 Photo Quality: Panoramic photographs will be of such quality as to permit the resolution of an adequately illuminated Air Force test pattern at a level of [redacted] Tests shall be conducted for qualification and acceptance of equipment using an Air Force test pattern of the type defined in MIL-STD-150A. Target contrast shall be that required to present 2:1 contrast at the camera mirror. 25X1D

3.4.2 Location Accuracy: The system design objective for location accuracy of any point on the panoramic photograph shall be ± 2 miles.

3.4.2.1 Time recording to an accuracy of 10 milliseconds will contribute a maximum uncertainty of ± 1/20 mile.

3.4.2.2 Positioning of the optical axis to within ± 15 minutes of arc will result in a possible error of ± 1/10 mile.

SPECIAL HANDLING

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 4 OF 28 SHEETS

3.4.3 Lifetime: The mission life will be one to four days during which photographs can be taken at intermittent times.

3.4.4 Swath Width: The panoramic camera shall provide ability to photograph selected target areas having a nominal swath width corresponding to a scan angle of 21.72 degrees, and having photographic quality per paragraph 3.4.1. Additional scanning for acceleration and deceleration may be necessary.

3.4.5 Stereo: Stereo photography will be 8 frames forward and 8 aft along the vehicle flight path. There will be a dead zone between photographed areas equal in length to the length of the target photographed. The stereo will have a fore and aft convergence angle of 30 degrees. The camera shall be capable of vertical photography and may be commanded in flight to provide stereo photography. Stereo mode shall be primary; therefore monoscopic mode shall be secondary.

3.4.6 Roll Positioning: Roll positioning of the camera will be provided for selection of targets not directly beneath the flight path. The maximum roll angle to be provided will be 30 degrees. A signal indicating the angle of roll with respect to vertical will be provided in five (5) discrete positions (-30° -15° -0° $+15^{\circ}$ $+30^{\circ}$) to allow correction of the IMC system and to film-record the roll angular command in the auxiliary data block. The nominal response time for cam positioning shall be 60 seconds from -30° to $+30^{\circ}$ roll.

3.4.7 Scan Overlap: Approximately 10 percent overlap at nadir between successive panoramic scans shall be provided.

3.4.8 Operate Cycle: 16 scans shall constitute a minimum basic panoramic camera operating cycle. Additional camera start pulses will be required to continue operation in periods of 16 frames.

3.4.9 Continuous Cover: Once placed in operation, the camera shall have the ability to operate in a continuous manner for a maximum of 20 minutes during the mission duty cycle.

3.4.10 Programming: The orbital programmer will be used for commanding operation.

3.4.11 Environmental Performance: The camera subsystems shall perform within the limits established in this specification when exposed to any natural combination of the environments specified.

SPECIAL HANDLING

	TITLE SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 5 OF 28 SHEETS

3.5 Vehicle, System Characteristics, and Interfaces

3.5.1 V/h for IMC: Ground selection of a suitable time varying V/h ramp will be required via real time command. The median velocity/altitude ratio shall be 0.03442 radians per second. The system will be capable of accepting commands in the V/h range 0.0231 to 0.0482 radians/second and will accomplish IMC. A minimum of 10 ramps will be provided. These ramps will be adjusted prior to flight to narrow the design V/h range by a factor of 3 for improved V/h accuracy. Ramp repeatability, once set, shall be one (1) percent. The system shall be capable of operating on either increasing and decreasing V/h conditions but must be determined prior to flight. A more accurate V/h programmer offering both increasing and decreasing V/h changes and requiring more command information for better time varying selection will be developed and presented to SE for incorporation in deliverable cameras when available.

3.5.2 Vehicle Stabilization Requirements

3.5.2.1 Angular Deviations

Roll ± 1 degree

Pitch ± 3 degrees

Yaw ± ½ degree (corrected for earth's rotation). Capability to change the yaw of the vehicle from 0 to 3.6 degrees at a rate of 0.16 degrees/minute commensurate with the inclination angle will be provided by the associate.

3.5.2.2 Residual Angular Velocities

Roll and pitch ± 0.6 degrees/minute

Yaw ± 3.0 degrees/minute

3.5.2.3 Momentum Balancing: No momentum balancing is to be provided. Panoramic camera supply and take-up spools shall be counter-rotating.

3.5.3 Camera Compartment Environment

3.5.3.1 Pressure: The camera compartment will be unpressurized.

SPECIAL HANDLING

	TITLE SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 6 OF 28 SHEETS

3.5.3.2 Temperatures: During photographic operation, temperature of the panoramic camera shall be maintained at 70 degrees F ± 10 degrees F. Gradients on the take-up cassette ranging from 20 degrees F to 180 degrees F can be expected during recovery. Gradients and transients affecting lens and structure maintaining focal length will be controlled to tolerable levels by thermal design. Thermal design shall:

a. Establish the same uniform ambient temperature of the lens cell and the platen support tube to aid in maintaining focus using passive thermal control wherever possible.

b. Minimize mirror temperature gradients.

c. Provide cooling for camera electronics and electromechanical devices.

d. Provide thermal protection for the film near heat sources greater than 150 degrees F and maintain thermal stability of film areas.

To assure stable operational temperatures, emissive coatings and thermal insulation will be applied on those areas of the camera structure and components as shall be mutually agreed upon by Itek and the associate. Specific power dissipating components and temperature-sensitive components or subassemblies shall be the subject of special consideration for negotiation by the associate contractors with System Engineering.

3.5.3.3 Light-Tight: The associate structure which serves as a camera compartment will be constructed in such a manner as to prevent light other than image forming light from falling on and exposing the film at any time. Light boots within the camera to meet this requirement will be provided by Itek.

3.5.4 Auxiliary Data Film Record

3.5.4.1 Time Signal: A digital clock (associate-furnished) will operate in conjunction with the camera subsystem by supplying signals for illumination of 29 lamps in the data blocks of both the panoramic and the stellar/index cameras. It will be capable of storing time unambiguously for a period of 5 days in increments of 0.01 second or less. A readout will be provided to transfer the clock reading to the film once per frame, and a serial binary readout will be provided to transfer the clock reading via the telemeter. The clock error will not exceed 10 milliseconds in any 12-hour period after accounting for clock drift and offset. Clock readout will be initiated by lens scan angle at center of format and clock readout must be exposed in 200 milliseconds or less. The maximum repetition rate of the panoramic clock interrogate signals is approximately 1.25 seconds per cycle. Clock output will be 15V ± 1/2V. Output pulse duration shall be adjustable from 40 to 100 milliseconds.

3.5.4.2 Stereo: Three lights indicating mirror position will be provided.

3.5.4.3 Roll Steering: Three lights indicating IMC cam angular position will be provided.

3.5.4.4 Film Information: An edge mask shall be provided for photo-recording fiducial and shrinkage marks, and picture format in accordance with Itek drawing 43704.

3.5.4.5 Attitude Information: The stellar camera, of the stellar/index camera subsystem will supply photographic records of roll and pitch positioning to 0.1 degree accuracy.

3.5.4.6 Scan Rate: Scan rate shall be determinable from film data to at least ten percent (10%) accuracy.

3.5.5 Electrical Power: SP2-156 delineates the electrical connectors that shall be provided.

3.5.5.1 Electrical Power (maximum):

Power Source	V/h Generator	Cassette Heater Power	Required Camera Avg. Pwr. During Operate	Total Avlb. Energy During 100/hr. Flg. incl. Htrs.
Plus 22.00 to plus 29.25 VDC unregulated		15w*	600w	1900 w/hrs.
Plus 28.3 VDC plus or minus 2.0 percent regulated			100w	1875 w/hrs.
Minus 28.3 VDC plus or minus 2.0 percent regulated			50w	125 w/hrs.
115V plus or minus 1 percent single phase 400 cps plus or minus 0.02 percent	10w for 40 min.*		35w	80 w/hrs.

* as programmed

SPECIAL HANDLING

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 8 OF 28 SHEETS

3.5.5.1.1 Starting Transient: Maximum starting transient load on the unregulated DC supply shall not exceed 1500 watts and shall be limited in duration to a maximum of 1 second at the beginning of each operate period.

3.5.5.1.2 Recurring Peaks: Maximum recurring peaks shall not exceed 1000 watts of unregulated DC not exceeding 500-millisecond duration during camera operation.

3.5.5.1.3 Noise Level: Past experience has indicated that considerable noise may be present in these sources. All electrical circuits and controls should be designed to be capable of operating in the presence of noise as high as 2.0 v (peak-to-peak) due to 2000 cps regulation on the plus and minus regulated DC power supplies. Transients of ± 10 volts of 10-millisecond duration may be experienced.

3.5.5.1.4 Ascent Phase: If required during ascent, the vehicle will supply 50 watts of +28 volt unregulated power continuously and 150 watts of +28 volts regulated power immediately after launch to the camera subsystems. Should this power be required, all tests will be performed under simulated conditions of power.

3.5.6 Programmer: Camera ON/OFF operation using "auto cycle" pulse command, V/h programmer synchronization, stereo/mono mode, discrete roll positioning command signals and stellar/index ON/OFF commands shall be provided by the command programmer. An "auto cycle" mode of 16 frames will be initiated upon receipt of a command pulse (0.05 minimum to 0.50 maximum second duration). Each additional continuing operation requires an additional pulse occurring not sooner than 2 seconds after the first pulse and not later than 2 seconds prior to normal camera shutoff after 16 frames at maximum V/h. Number of scans during auto cycle is identical for both stereo and mono modes.

3.5.7 Commands: Signals for the operation of the equipment must be obtained. The operation signals to be provided are as follows:

COMMAND	SIGNAL SOURCE	LOAD
Panoramic burst pulse	1 relay	1 amp. max.
V/h - IMC - Selection of best time function for internal V/h approximation. A pulse train signal will make this selection via real time command.	Command link	24-volt stepping switch coil

SPECIAL HANDLING

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 9 OF 28 SHEETS

COMMAND	SIGNAL SOURCE	LOAD
V/h Generator Command (ON/OFF)	1 relay	1 amp. max.
Stereo/mono mode selection	1 relay	1 amp. max.
Roll Steering IMC cam control (during time camera rolled)	3 binary-coded relays	1 amp. max.
Stellar/index intervalometer command (ON/OFF)	1 relay	1 amp. max.

3.5.8 Stellar/Index Control and Programming: The associate shall provide a signal to initiate and continue operation of the Stellar/Index Camera Subsystem, as required throughout the mission. The panoramic camera will act as the intervalometer, proportional to V/h, and provide all subcycle commands required by the stellar/index camera, whether or not panoramic photography is being accomplished. Stellar/index photography will be accomplished at a ratio of one exposed frame for every ten panoramic cycles and expose no more than three (3) S/I frames for each sixteen (16) frame bursts of the panoramic instrument. The S/I camera shall operate whenever the main instrument operates independent of whether or not an "intervalometer" command is received. The S/I Camera can operate without the main instrument by applying "intervalometer" command. This ratio provides 50 to 65 percent overlap at all V/h ratios.

3.6 Design: The panoramic camera is intended to provide high resolution stereoscopic or monoscopic photographs of selected target areas. It is an integral system whose operation shall be sequence-programmed and automatic upon command, including film transport, scanning, IMC, and auxiliary data recording. The basic design (Hyac-type panoramic) utilizes a curved focal plane arc containing stationary film with panoramic scanning accomplished by rotation of the lens about its nodal point. It will accomplish both vertical and fore and aft stereo photography by tilting a mirror.

3.6.1 Configuration: The design of the camera shall be such so as to permit installation in an envelope as defined by Drawing Number T55-100.

3.6.2 Mechanical Interface: In accordance with Drawing Number T55-100.

3.7 Construction: Within the limits of weight and space available, construction techniques, processes, and materials shall be selected to provide the maximum in structural integrity for the environment to be encountered.

3.7.1 Suspension: The principle parts of the camera shall be designed for the panoramic camera to be operated as an integral unit. The principle parts of the camera are the lens drive assembly, mirror and drive assembly, shutter platen assembly, film transport mechanism including supply spool, film "dancer" loops and associated parts and drive mechanism, and a take-up cassette including spool and drive located in the recovery capsule. The panoramic camera shall be supported by the external skin of the vehicle and held in such a way to maintain alignment with the cassette and the stellar/index subsystem, per T55-100.

3.7.2 Maintaining Focus: The support of the film platen shall establish and maintain the distance from the lens nodal point to the film to the accuracy required to attain the specified resolution. Construction of the lens cell, the structure maintaining focal length and the platen assembly shall ensure that the spacing from lens to film will not be changed due to launch acceleration, vibration, and shock. The construction and materials shall maintain focus during and subsequent to the uniform ambient temperature variations expected.

3.7.3 Film Thermal Shielding: Film paths and equipment near high-temperature external skin shall be properly thermally shielded if required.

25X1D

3.8 Performance

3.8.1 Photographic Quality: The high-acuity panoramic camera, when operated, will produce a minimum degradation of static lens-film resolution. The design objective shall be 90 percent of the static AWAR lens-film resolutions obtained on the Mann Bench. The camera shall produce photographs with an AWAR resolution of [redacted] or greater when operated under simulated flight condition utilizing the DRT with a moving Air Force Test Pattern as defined in MIL-STD-150. Target contrast shall be that required to present 2:1 contrast at the camera mirror.

3.8.2 Image Motion Compensation Accuracies: The forward motion compensation mechanism and the scan drive system shall have performance compatible with the design requirement pertaining to photographic quality and five (5) to fifteen (15) percent overlap.

SPECIAL HANDLING

3.8.3 Lens Drive Smoothness: The lens drive system, which is used for focal plane scanning in addition to forward motion compensation shall be smooth such that no objectionable banding occurs on the photography of ground scenes. For measurement purposes, the amount of banding present will be determined using a stable diffuse DC light source or a strobe light.

3.8.4 Exposure Control Evenness: Banding caused by non-uniform lens motion shall be controlled to produce less than 0.15 Log E change in exposure. The Delta Log E exposure change shall be determined by reference to the straight-line portion of SO-132 sensitometric control film printed and normally processed with the banding exposure test per Specification 0004, Process Specification.

3.9 Major Components: The high-acuity panoramic camera shall consist of:

3.9.1 Film

3.9.1.1 Base: The camera shall be designed to utilize SO-132/130 or equivalent thin base (0.0035-inch) polyester film. Use of polyester materials varying in thickness between 1.8 and 4 mils will be a design objective.

3.9.1.2 Emulsions; The camera will be capable of handling and exposing Eastman Kodak films Special Order 132/130 or other films having equivalent or better photographic emulsions and physical properties.

3.9.1.3 Width: The system will use 5-inch wide film.

3.9.1.4 Spooled Film: The spooled film shall be in accordance with Itek Specification 49346.

3.9.1.5 Format: The format will be in accordance with Itek Drawing Number 43704.

3.9.2 Film Transport System: Film will be stored on supply and take-up spools. During camera operation, these spools will be driven at essentially constant speed which will be determined by the required cycling rate. (Proportional to V/h.) An intermittent transport system will meter unexposed film into the platen area between photographic scans. The film on the platen will be held stationary during the scanning portion of each cycle. Dancer loops will be utilized to store film supplied and taken up during scan. Supply and take-up spools will be controlled in a manner to maintain the proper amount of film in the dancer loops, thus preventing slack loops or excessive film tensions. The film path will be designed to ensure proper tracking of the film and to eliminate the possibility of film tear or damage to the emulsion. The film transport system will be designed to minimize static discharge in the active format area in aerial scenes.

3.9.2.1 Allowance for Film Splices: The film handling system and guides shall be designed to allow for smooth passage of the required number of proper film splices expected in each roll of operational film. The film transport shall be capable of passing film that has been properly butt-spliced with 1-inch wide polyester film tape (Minnesota Mining and Manufacturing Company, Type Number 850 or equivalent).

3.9.2.2 Space Between Formats: The space between adjacent formats will be utilized for data recording. The maximum space permitted between picture formats shall be in accordance with format Drawing 43704.

3.9.2.3 Rollers: All rollers in the film transport mechanism shall be consistent with good design practice determined by the type of film to be used. A minimum diameter of one inch shall be used.

3.9.2.4 Film Loading: The camera shall be capable of being loaded in subdued light using live film protected by 30 feet of leader.

3.9.2.5 Loss of Overlap During Camera Start: The allowance for loss of overlap during any starting of the film transport mechanism shall be a maximum of two (2) frames. From the time the start sequence command is received, the camera system shall be up to speed in approximately five seconds.

3.9.3 Supply and Take-up Spools

3.9.3.1 Capacity: Approximately 7500 feet of thin-base Estar 5-inch film (3-1/2 mil) (weight 75 pounds). A constraint on film capacity is that the recovery capsule of the system can only accommodate a film spool approximately 20 inches in diameter.

3.9.3.2 Interchangeability: Spools will be removable and interchangeable between cameras.

3.9.3.3 Flanges: The flanges will be removable from the hub.

3.9.4 Cassette

3.9.4.1 Basic Design: The cassette will consist of the take-up spool and film take-up drive systems for the panoramic camera mounted in a unit structure to allow installation in the recovery system. The panoramic take-up spool and drive shall be controlled by the panoramic camera film transport mechanism. Consideration will be given in the cassette design for spool removal in dark conditions. The total power consumption of the cassette shall be held to a minimum.

SPECIAL HANDLING

3.9.4.2 Configuration: The design of the cassette will conform to the basic configuration and space limitation as shown by Drawing Number T55-100. Provision will be made for mounting the cassette within the vehicle in accordance with the mounting provisions as shown in Drawing Number T55-100.

3.9.4.3 Instrumentation

3.9.4.3.1 Thermal Instrumentation: One Ruge BN 2400 resistance thermometer will be installed in the cassette.

3.9.4.3.2 Maximum Temperature Indicator: A passive method of indicating maximum temperature in excess of 200 degrees F experienced by the take-up spool will be provided.

3.9.4.3.3 Remote Film Footage Indication Requirement: The panoramic take-up spool shall be provided with a transducer and the necessary electrical connections to permit remote indication of the amount of 5-inch film that is on the 20-inch take-up spool at any time during the operation. This shall be accurate within 5 percent over the total spool radius.

3.9.4.4 Design Requirements

3.9.4.4.1 Cassette Weight: The weight of the complete cassette with empty spools without film shall be held to a minimum and shall not exceed 20 pounds.

3.9.4.4.2 Film Loading: The cassette shall be assembled with polyester leader attached to the spool and threaded through the film handling system with six feet of leader external to the cassette film entrance slot. This leader shall be spliced to the camera film for final assembly and testing purposes.

3.9.4.4.3 Film Capacity: The cassette shall contain a film spool of special design with a minimum diameter core and a 20-inch diameter flange capable of handling a film capacity of 19-15/16-inch diameter. The spacing between flanges shall be 5.0 $\pm$ 0.005 inches at the hub. Total run-in shall not exceed 0.030 inches at any point.

3.9.4.4.4 Panoramic Anti-Backup Device: The cassette shall be designed to incorporate a brake in the spool drive system to prevent the take-up spool from unwinding. This brake shall be capable of being released for test and checkout purposes by applying 28 volts DC on an appropriate pin connection. The brake shall be mechanically engaged when the voltage is removed.

SPECIAL HANDLING

3.9.4.4.5 Cassette Heaters: Any required heaters, to maintain 70 ± 10 degrees F as may be specified by SE, shall be Itek responsibility. The heater circuit will be on unregulated DC. Heaters will be controlled by an internal thermostat. Heater power will not exceed 15 watts.

3.9.4.5 Panoramic Take-up Performance: The take-up shall be capable of taking up the required amount of film as specified and shall be able to be started and stopped at least three hundred times during the taking up of a complete four-day roll of film under simulated duty cycle. The acceleration time shall be such that no slack loop will be formed during camera system operation. Film tension shall at all times be maintained between 1/4 to 2 pounds.

3.9.5 Optical System: Specification MIL-STD-150 shall be used as a guide in the design, manufacturing, and testing of the 66-inch lens.

3.9.5.1 Optical Characteristics: The optical characteristics of the lens, mirror, and filter shall meet the photo quality requirements of paragraph 3.4.1 when using the photographic film supplied per paragraph 3.9.1.

3.9.5.2 Lens: The panoramic camera lens is a 66-inch f/5 modified Tessar (Hyac type). The resolution shall approach diffraction limited performance at high contrast. Each lens will have focal length of 66 ± 0.25 inch. Custom lens/film plane assemblies may be required and hence need not be interchangeable. The lenses shall be calibrated so that nodal points will be nearly coincident with the axis of rotation and the focal length will be maintained at operational altitude and temperature of 70 ± 10 degrees F (see paragraph 3.5.3.2).

3.9.5.3 Cell: A beryllium or other suitable material cell will house the optical elements.

SPECIAL HANDLING

3.9.5.4 Stereo Mirror: The mirror shall not contribute a significant loss to the optical system. Every effort shall be made to minimize temperature gradients through thermal design, specifying shielding, etc.

3.9.6 Photographic Filter: A photographic filter shall be mounted in the optical path. This filter shall not degrade the photographic image when the camera is used for its intended purpose. The filter shall be of the proper value for the selected film emulsion to be used as a haze filter (similar to Wratten 21 - minus blue).

3.9.7 Scanning Drive and Shutter Mechanisms: A scan drive and shutter mechanism will be provided to drive the lens and exposure slit in synchronism. Scanning speed and scan cycling rate will be proportional to V/h and will be designed to provide approximately 10 percent overlap, at the nadir, between successive frames. Scanning speed during exposure will be held constant to meet the requirements of paragraph 3.8.3 and 3.8.4 to provide good positional determination and to minimize IMC error. The lens will be in a latched position during launch.

3.9.8 Stereo Mirror Drive: The mirror and drive will be capable of providing for vertical photography and a fore and aft stereo convergence angle of up to 30 degrees (i.e., $\pm$ 15 degrees of vertical). The drive will tilt the mirror either fore or aft (in the stereo mode) and maintain its position fixed during scan. In the vertical mode, the drive will simply tilt the mirror to center position and hold it there. The mirror will be in stow position during launch.

3.9.9 Image Motion Compensation System: The cameras will be designed for a median V/h = 0.03442 radian/second. Upon receipt of proper IMC function selection, the system will compensate for ground motion and change cycling rate in such a manner as to maintain design overlap within the operating range. Frame to frame cycle times range from approximately 1.27 to 2.97 seconds over the design V/h range.

3.9.10 Exposure: Exposure shall be accomplished by utilizing a focal plane shutter. Exposure time may be varied by installing a fixed slit of appropriate width prior to flight. A maximum of 10 fixed slits will be provided between 1/32-inch and 3/4-inch width in increments of 1/2 f-stop. These slits will be interchangeable.

SPECIAL HANDLING

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 16 OF 28 SHEETS

3.9.11 Fiducial and Shrinkage Markers: Fiducial and shrinkage marks will be per Drawing 43704.

3.9.12 Telemetering Data Transducers: In accordance with SP2-156 Electrical Interface.

3.9.12.1 Thermal Instrumentation: Ruge BN 2400 resistance thermometers or equivalent will be installed in the camera to monitor the temperatures of critical structures and components. Temperature sensors shall be located as mutually agreed upon between System Engineering and associate contractors.

3.9.12.2 Functional Instrumentation: As defined in SP2-156 Electrical Interface.

3.10 Paragraph Deleted

3.11 Checkout Equipment

3.11.1 Control and Power Console: Shall be provided in accordance with the following equipment complement and functional requirements. Manual commands (switch excitation) for laboratory testing of the panoramic camera shall be provided. Inputs to the camera shall be provided manually, and no attempt shall be made to simulate the rate at which signals are received from the programmer. Provision for use of a direct writing recorder shall be made. (No recorder to be furnished.) The following supplies, including short circuit protection and adjustable meter relays for protection of the camera, shall be provided:

+24 VDC Battery: A regulated, adjustable, d-c supply to simulate the unregulated battery supply. This supply shall be adjustable over the range from 22.00 to 29.25 volts. It shall have a continuous output rating of 1500 watts. Internal impedance shall not exceed 0.05 ohms.

+28 VDC Regulated: A +28.3 VDC, ± 2 percent, regulated supply capable of supplying 300 watts continuously. This supply shall have an adjustable 1 V rms of 2000 cps ripple that may be superimposed on its output.

-28 VDC Regulated: A -28.3 VDC, ± 2 percent, regulated supply capable of 150 watts continuous putput. This supply shall have an adjustable 1 V rms of 2000 cps ripple that may be superimposed on its output.

Single-Phase, 400-cps: A single-phase, ungrounded, 400-cps, ± 0.02 percent, 115 V ± 1 percent regulated supply. The harmonic distortion of the supply shall be less than 5 percent when supplying a 50-watt load.

3.11.2 Checkout Console: A checkout console is defined as a two-bay control and power console as mentioned in paragraph 3.11.1 with the addition of a thrid bay consisting of the following equipment:

Input Scanner: A Non-Linear Systems Model 262 input scanner, Itek modified, shall be provided for rapid monitoring of functional and environmental instrumentation.

Data Printer: A Non-Linear Systems Model 155 data printer for recording of functional and environmental instrumentation.

Digital-Volt-Ohmmeter: A Non-Linear Systems Model M-24 digital volt-ohmmeter for measuring functional and environmental instrumentation.

3.11.3 Instrumentation Console: Instrumentation Console shall include:

One Tektronix RM35A Oscilloscope

One digital voltmeter, AC/DC type NLS Model M-24 with Model 125E AC/DC Converter

One Hewlett-Packard Model 410B VTVM.

SPECIAL HANDLING

4.0 TEST REQUIREMENTS

4.1 General: The tests listed are to be performed in accordance with the requirements stated within this specification.

4.1.1 Test Location: Itek Laboratories, Lexington, Massachusetts.

4.1.2 Witnessing of Tests: Tests may be witnessed by the following:

System Engineering (SE)

Itek-authorized representatives

Other personnel designated by customer.

4.1.3 Records of Tests and Reports: Test data shall be recorded. The contractor shall prepare test reports covering the results of tests required in this specification referencing the results of each test to the applicable test specified herein.

4.1.3.1 Camera Subsystem Qualification Test: All qualification test results shall be reported to SE, giving in detail all failures, repairs necessary, and malfunctions not resulting in failure. "Failure" is defined as being caused by the camera and "malfunction" is defined as being caused by GSE, personnel, procedure deviation, etc.

4.1.3.2 Subassembly Qualification: Reports on subassembly qualification tests shall be submitted to SE and the customer.

4.1.3.3 Acceptance Test: The acceptance test shall be reported to SE.

4.1.4 Test Conditions: Applicable test conditions specified in 6117 shall be used.

4.2 Classification of Tests: Inspection and testing shall be classified as follows:

4.2.1 Qualification

4.2.1.1 Camera Subsystem Qualification Tests: Qualification test, or preproduction tests, shall be run by Itek in Boston on a complete camera subsystem, to demonstrate compliance with the subsystem performance requirements. The individual tests shall be run with no adjustments or repairs during the course of the test. If any modifications are

necessary after the completion of any qualification test, the test must be re-run, unless explicit waiver is granted upon demonstration that the modification will not affect the response to the particular test. The camera shall be qualified under the applicable portions of 6117, using environments specified for the "Payload Area."

4.2.1.2 Subassembly Qualification: Subassemblies of the panoramic camera subsystem shall be separately qualified under the applicable portions of 6117, using environments specified for Payload Area. Subassemblies need not be given qualification tests if prior qualification under test conditions at least as severe as required in this specification can be documented or if waiver is granted by SE/TD upon review. Specific acceptance must be granted by SE/TD for each subassembly not subjected to qualification. Parts must function correctly following exposure to qualification test requirements.

4.2.2 Acceptance Tests: Acceptance tests shall be run on production units to verify workmanship and operability. The individual tests shall be run with no adjustments or repairs during the course of the test. If any modifications or repairs are made following the completion of any acceptance test, all tests previously run on the unit must be repeated, unless an explicit waiver is granted by SE/TD, based on the demonstration that the modification or repair will not affect the response to the particular test or tests.

4.3 Qualification Test: The environments specified in 6117 are for ascent and on-orbit. After simulated ascent environment, satisfactory camera operation must be demonstrated. The shock in paragraph 4.3.2.1.2 is applicable to the cassette subassembly for recovery environment after which, operation is not required but disassembly will be demonstrated. (See paragraph 3.9.4.1.)

4.3.1 Camera Subsystem Qualification Tests

4.3.1.1 Shock Test: Deleted per revision A.

4.3.1.2 Vibration Test: The camera shall operate after being subjected to the required vibrations. Operation during vibration is not required. The provisions of paragraph 4.10 of 6117 shall apply and Table V with the following modifications: White noise testing is not required.

4.3.1.3 Thermal Altitude: An endurance run, corresponding in duration to the mission duration shall be run, at simulated altitude, and internal thermal environment specified. The duration of the test shall be 96 hours. The operation of the equipment will approximate the normal duty cycle. The test shall be run using a simulated vehicle power supply. No adjustments shall be made during the test. Loss of altitude during the test, to pressures greater than 0.001 mm Hg shall invalidate the test. At least 48 hours of the normal duty cycle during this test shall be at maximum cycling speed. The test shall be run at a pressure of less than 0.0001 millimeters mercury absolute pressure. The equipment shall be mounted in vehicle fairing, and jig-type take-up cassette used. The temperature shall be maintained at 70 $\pm$ 10 degrees F for the duration of the test.

4.3.1.4 Voltage Sensitivity: Tests shall be run at high- and low-input voltages, with noise and ripple up to 2.0 volts peak-to-peak at 2000 cps on the power supply. The equipment shall be operated at atmospheric conditions, at both maximum and minimum cycling rates over the range of operating voltages specified in this specification.

4.3.1.5 Acceleration Tests: The camera shall operate after being subjected to the required accelerations. Operation during the acceleration phase is not required.

4.3.1.6 Optical Resolution: The camera shall meet the optical resolution requirements of this specification as stated in paragraph 3.8.1 of this specification. The optical resolution shall be measured at vacuum conditions. This test shall be run after the completion of all other tests.

4.3.1.7 Temperature Tests: The following tests will be accomplished to establish equipment operating capabilities at predicted extremes of temperature. It is recognized that subsystem performance parameters may be degraded since these temperatures are beyond normal operational design limits.

4.3.1.7.1 High Temperature: The camera shall be operated after stabilization at high temperature. The equipment shall be operated at a temperature of 95 + 5 - 0 degrees F at a pressure of 0.001 mm mercury absolute for at least 100 cycles each at minimum and maximum cycling rates.

4.3.1.7.2 Low Temperature: The camera shall be operated after stabilization at low temperature. The equipment shall be operated at a temperature of 45 - 5 + 0 degrees F at a pressure of 0.001 mm mercury absolute for at least 100 cycles each at minimum and maximum cycling rates.

4.3.2 Subassembly Qualifications: Panoramic camera subsystem subassemblies shall be subjected to all tests called for in Camera Subsystem Qualification Tests as outlined. However, alternate versions of the Thermal Altitude endurance run may be substituted where applicable.

4.3.2.1 Shock Test

4.3.2.1.1 Ascent Shock: The camera subassemblies shall operate after being subjected to the required shocks. Operation during shock is not required. The provisions of paragraph 4.9 of 6117 are applicable. Table III, Payload (preliminary) test conditions shall apply.

4.3.2.1.2 Recovery Shock: The cassette shall be capable of withstanding the following shock test with a full spool of film without damage to the film nor degradation of the information recorded thereon. It shall be capable, furthermore, of withstanding said shocks without structural alteration which would cause damage to the film or degradation of the recorded information during subsequent disassembly of the cassette. Subject the cassette to 3 shocks along each direction of both X and Y axes for a total of 12 shocks of 5g magnitude and 6 millisecond duration (half sine pulse). Subject the cassette to 20 g's for 3 shocks in each direction along X axis. Axes defined in T55-100.

4.3.2.2 Altitude: The equipment shall be operated at a pressure of less than 0.0001 mm mercury absolute pressure, for a normal four-day mission.

4.3.2.3 Voltage Sensitivity: The equipment shall be operated at atmospheric conditions at high and low voltages required in paragraph 4.3.1.4.

4.3.2.4 Temperature Tests: The following tests will be accomplished to establish equipment operating capabilities at predicted extremes of temperature. It is recognized that subsystem performance parameters may be degraded since these temperatures are beyond normal operational design limits.

4.3.2.4.1 High Temperature: The equipment shall be operated at a temperature of 90 + 5 - 0 degrees F at a pressure of 0.0001 mm mercury absolute for 30 minutes.

4.3.2.4.2 Low Temperature: The equipment shall be operated at a temperature of 45 + 0 - 5 degrees F at a pressure of 0.0001 mm mercury absolute for 30 minutes.

SPECIAL HANDLING

	TITLE SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	3961
		Sheet 22 of 28 Sheets

4.3.2.5 Electronic Package High and Low Temperatures: Electronic packages shall be run for 30 minutes under simulated load and mounting, after stabilization at a pressure of 0.001 mm mercury absolute at 125 ± 5 degrees F. They shall also be subjected to the same test conditions except temperature stabilization shall be 40 + 0 - 5 degrees F.

4.3.2.6 Vibration Test: The subassemblies shall operate after being subjected to the required vibrations. Operation during vibration is not required. The provisions of paragraph 4.10 of 6117 shall apply and Table V with the following modifications: White noise testing is not required.

4.4 Acceptance Test Minimum Requirements

4.4.1 Mating Test: The camera will be placed on a test fixture simulating the mechanical interfaces. This test fixture will be a precision instrument and the camera must fit the interface without alteration of the fixture. The camera system must align on all axes and must operate in accordance with this specification.

4.4.2 Functional Operation Test: With the simulated electrical interface of the checkout console, the camera will operate satisfactorily and respond to simulated commands. The camera shall be loaded with film and operated in both vertical and stereo modes in the horizontal attitude. The total film load shall be the maximum amount. At least 25 percent of the total film capacity should be operated through the camera during acceptance tests. This amount of film shall operate satisfactorily during the test without an assist of any manner whatsoever. The camera shall be started and stopped at least twenty-five times without any erratic operation or mishandling of film. Any malfunction of loops, tracking or dancer rollers may be corrected, but the complete test shall be re-run.

4.4.3 Vibration Test: The camera mounted on the test fixture shall be placed on a vibration table and tests shall be run at prevailing room conditions. Test levels shall be selected such that levels attained will simulate those experienced during launch. After test, the camera shall be inspected for any visual defects. The equipment shall operate after being subjected to vibration in each of three mutually perpendicular axes, at a level of 1/2 to 1 g peak-to-peak using a frequency sweep program from 20 to 2000 cps at constant octave rate for a sweep time of 15 minutes, followed by a sweep from 2000 cps to 20 cps. The camera shall be operated for at least 100 cycles at maximum cycling rate following vibration. The optical resolution shall be measured in vacuum conditions following the vibration testing.

4.4.4 Electrical Insulation Tests: All electrical circuits shall be checked to the frame of the camera with a single application of 100 volts dc on 28-volt circuits and 300 volts dc on 115-volt circuits, and shall show a resistance of 1 megohm or greater. The wire harness shall be tested to the limits of 1072045 prior to the connection of subassemblies and components using 1000 volts dc megger limits.

4.4.5 Resolution Test: The camera shall be mounted in a fixture in the dynamic resolution tester using moving resolution targets described in paragraph 3.8.1. The camera shall be loaded with a test spool of unexposed film. The camera shall be operated and photograph the test patterns under dynamic conditions, to demonstrate satisfactory operation of the IMC control system and perform resolution tests in accordance with paragraph 3.8.1.

4.4.6 Fogging and Format Test: During operation of the camera, simulated auxiliary photo recording data shall be fed to the camera auxiliary data recording system. This data shall be examined upon developing of the film, to ascertain satisfactory operation.

4.4.6.1 Format Inspection: The length, width, and spacing of the format shall be measured to ascertain that these dimensions are within the design accuracy. The film shall be examined to ascertain that the fiducial and shrinkage marks are clear and readily discernible.

4.4.6.2 Light Tightness: A fogging test of live film will be administered to demonstrate the light tightness of the Panoramic Camera Subsystem per paragraph 3.5.3.3.

5.0 PREPARATION FOR DELIVERY

5.1 Packing and Packaging: Packing and packaging shall be adequate to protect all equipment when shipped or stored.

5.2 Handling, Mating, and Checkout: Adequate protective devices will be supplied.

APPENDIX A

Exceptions to 2.0 APPLICABLE DOCUMENTS

1.0 Exceptions to 6117B:

a. Change paragraph 1.1.5 to read "AET Engineering Department of Contractor."

b. Delete paragraph 1.2.2.1 and substitute "Equipment shall be transported by military transport aircraft and motor vans. The equipment shall be protected and packaged to withstand such conditions as well as shock and vibration prevalent during shipping."

c. Delete paragraph 1.2.3 and substitute "Contractor storage facilities will ordinarily be air-conditioned. However, heat and high humidity may occur, and equipment should be able to withstand such conditions."

d. Delete paragraphs 1.2.4.1, 3.2.1.4, 3.2.1.5, 4.3.1, 4.4, 4.6, 4.7, and 4.8.

e. Change paragraph 2.1 to read "MIL-E-5272C (ASG)-13 April 1959 and Amendment No. 1, 20 January 1960 - Environmental Testing, Aeronautical and Associated Equipment, General Specification for" - all other MIL standards not applicable.

f. Delete paragraph 2.4.

g. Delete paragraphs 3.2.1, 3.2.2.2, and 3.2.2.3.

h. Change paragraph 4.1.1 to read "humidity of not more than 70 percent."

i. Paragraphs 4.3 through 4.8.3 - not applicable.

j. Delete paragraph 4.9.1 and 4.9.2.

k. Delete paragraph 4.10.1.

l. Table VI - not applicable.

m. Paragraph 4.10.2 will be used as a guide in preparing the Qualification Test Specification, Procedures, and design of the qualification fixtures.

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 26 OF 28 SHEETS

2.0 Exceptions to 447969A:

2.1 The following techniques, which have proved effective in the past will be employed for grounding and shielding and will satisfy the general intent of 447969A and the requirements of Specification 43961.

2.1.1 The chassis will in no case be used as a circuit path. There will be a minimum isolation of 1 megohm between chassis and all power and signal circuits.

2.1.2 Loads on each power category will be kept separated throughout the camera. That is, regulated return, unregulated return, 400-cycle return and TM return will not tie to each other in the camera.

2.1.3 No attempt will be made to float electronic chassis with respect to the structure.

2.1.4 Each electronic chassis will be tied electrically to a central chassis ground point.

2.1.5 All 400-cycle circuits will be run twisted shielded.

2.1.6 All shields at the interface, if picked up in the camera, will be carried through interface connectors to the load or signal source without commoning to other shield circuits and without being tied to any power return circuit or chassis.

2.1.7 Connector pins will be allocated to maintain spacing between power and signal circuits.

2.1.8 Shields will be grounded at but a single point. Shields will be insulated from each other in cable bundles.

2.1.9 Power distribution to subsystems not essential to the primary flight objective will be fused.

2.1.10 Wire sizes will be selected consistent with MIL-W-8160C.

2.1.11 Radio interference criteria will be applied for the entire camera rather than on a component or subassembly basis.

2.1.12 The overall schematic will show the shields and grounds distribution details.

2.1.13 New designs will incorporate, wherever feasible, the techniques outlined in 447969A.

2.1.14 The following techniques will be employed in the camera to reduce radio interference at its source.

2.1.14.1 Dual LC filters will be used in conjunction with all DC motors.

2.1.14.2 Diodes or arc suppressors will be used to reduce inductive transients on relay coils, brakes, and solenoids.

2.1.14.3 Mounts for motors, etc, are spot-faced to provide good contact with the frame.

	TITLE	
	SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		SHEET 28 OF 28 SHEETS

REVISION B/continued

Paragraph	Was	Is
3.5.8/continued		independent of whether or not an "intervalometer" command is received. The S/I Camera can operate without the main instrument by applying "intervalometer" command. This ratio provides 50 to 65 percent overlap at all V/h ratios."
3.8.1 25X1D	Last Sentence: "The camera shall produce photographs with an AWAR resolution of [redacted] or greater when operated under simulated flight condition utilizing the DRT with moving 2:1 Contrast Air Force Test Pattern as defined in MIL-STD-150."	25X1D "The camera shall produce photographs with an AWAR resolution of [redacted] or greater when operated under simulated flight condition utilizing the DRT with a moving Air Force Test Pattern as defined in MIL-STD-150." ADD: "Target contrast shall be that required to present 2:1 contrast at the camera mirror."
3.9.4.1	First Sentence: "The cassette will consist of the take-up spool and film take-up drive systems for the panoramic, index, and stellar cameras mounted in a unit structure to allow installation in the recovery system."	"The cassette will consist of the take-up spool and film take-up drive systems for the panoramic camera mounted in a unit structure to allow installation in the recovery system."
3.9.4.4.3	Last Sentence: "Capacity of stellar/index spools will be as specified in paragraph 3.10."	Delete in its entirety.

SPECIAL HANDLING

	TITLE SPECIFICATION FOR PANORAMIC CAMERA SUBSYSTEM	43961
		Sheet of Sheets

Paragraph	Was	Is
3.10 through 3.10.1.4	Section entitled "Stellar/Index Camera Subsystem"	Delete entire section - except paragraph 3.10.1.5 which is changed to paragraph 3.5.8.
3.10.1.5	Title: "Control and Programming:"	"Stellar/Index Control and Programming:"
	Next to last sentence: "Stellar/index photography will be accomplished at a ratio of one exposed frame for every ten panoramic cycles."	"Stellar/index photography will be accomplished at a ratio of one exposed frame for every ten panoramic cycles and expose no more than three (3) S/I frames for each sixteen (16) frame bursts of the panoramic instrument. The S/I camera shall operate whenever the main instrument operated independent of whether or not an "intervalometer" command is received. The S/I Camera can operate without the main instrument by applying "intervalometer" command."
4.4.4	Last sentence: "The wire harness shall be tested to the limits of 1072045 after installation in the camera but prior to connection of subassemblies and components."	"The wire harness shall be tested to the limits of 1072045 prior to the connection of subassemblies and components using 1000 volts DC megger limits."